

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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27 OCT 2000

COMP

NGO

Date of mailing
(day/month/year)

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

(PCT Rule 71.1)

12.10.00

Applicant's or agent's file reference
P22105/GWO

IMPORTANT NOTIFICATION

International application No.
PCT/GB99/02082

International filing date (day/month/year)
12/07/1999

Priority date (day/month/year)
11/07/1998

Applicant
VORGEM LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
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Authorized officer

Conner, M

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P22105/GWO		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/02082	International filing date (day/month/year) 12/07/1999	Priority date (day/month/year) 11/07/1998	
International Patent Classification (IPC) or national classification and IPC G01N21/73			
Applicant VORGEM LIMITED et al.			
<p>1. This international preliminary examination report has been prepared by this international Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 5 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none">I <input checked="" type="checkbox"/> Basis of the reportII <input type="checkbox"/> PriorityIII <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicabilityIV <input type="checkbox"/> Lack of unity of inventionV <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statementVI <input type="checkbox"/> Certain documents citedVII <input type="checkbox"/> Certain defects in the international applicationVIII <input type="checkbox"/> Certain observations on the international application			
Date of submission of the demand 04/02/2000		Date of completion of this report 12.10.00	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized officer Hoogen, R Telephone No. +49 89 2399 2192	



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/02082

1. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-13 as originally filed

Claims, No.:

1-31 as received on 31/07/2000 with letter of 28/07/2000

Drawings, sheets:

1/8-8/8 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☒ the claims, Nos.: 32
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/02082

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1-4, 6-11, 13-15, 20-30
	No: Claims 5, 12, 16-19, 31
Inventive step (IS)	Yes: Claims
	No: Claims 1-4, 6-11, 13-15, 20-30
Industrial applicability (IA)	Yes: Claims 1-31
	No: Claims

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/02082

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: DE 27 36 262 A (NORTHERN TELECOM LTD) 16 March 1978 (1978-03-16)

D2: WO 98 07002 A (BECKMANN WILLIAM GEORGE ;VORGEM LIMITED (GB); HICKS SIMON ERIC (GB) 19 February 1998 (1998-02-19) cited in the application

D3: US-A-5 225 888 (SELWYN GARY S ET AL) 6 July 1993 (1993-07-06)

2. Method claims 1-4

2a. Claim 1

Document D1 discloses a method of determining the progress of a plasma based etching process comprising the steps of continuously monitoring a predetermined frequency of radiation emitted from the plasma and of developing a graphical output corresponding to the level of emittance (cf. page 8, last para - page 9, first para). This graphical output is reproducible for subsequent etching processes and therefore enables an operator to obtain an indication of the progress of the process by visual comparison of the shape of the actual output with the predicted output. In particular the shape comprises several characteristic features which allow the determination not only of the end point but also of process progress (cf. page 9, last para - page 10, first para; figure 3).

From this disclosure the subject-matter of claim 1 differs only in that the comparison is performed electronically. The objective technical problem may therefore be regarded as how to automatize the method of process monitoring disclosed in D1. This problem is a standard problem in process automatization.

Once this particular problem has been formulated, it would be straightforward for the skilled person to replace the visual comparison of the shape of the measured signal with the shape of the predicted signal by an electronic comparison, thereby

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/02082

arriving at the subject-matter of claim 1 without the exercise of inventive skill. An indication towards electronic comparison is even provided in D1 where the use of a comparator circuit in addition to the graphical output is disclosed (cf. page 8, last para - page 9, first para).

2b. Claims 2-4

The additional features of these claims are known from D1 (cf. page 8, last paragraph - page 9, first paragraph; page 8, paragraph 3; page 9, last paragraph - page 10, first paragraph).

3. Apparatus claims 5-31

3a. Claims 5 and 12

Claims 5 and 12 translate the features of claim 1 into apparatus features and are not considered to be inventive in view of D1, the argumentation being analogous to the one given for claim 1.

In addition document D2 discloses a process control system for controlling a thin layer etching process including means for continuously monitoring an optical frequency differentiated sample of radiation reflected from or transmitted by the layer and shape recognition means in the temporal domain for comparing the measured output against a predicted output or trend to provide an indication of progress of the process (cf. abstract; page 6, line 32 - page 8, line 22).

The formulation "optical frequency differentiated radiation from the process" used in claim 5 and "time evolving spectral output from a reaction" used in claim 12 are so broad that the subject-matter of claims 5 and 12 does not meet the requirement of novelty in view of D2.

3b. Claims 6-11 and 13-31

Dependent claims 6-11 and 13-31 do not contain any features which, in combination with the features of any claim to which they refer, meet the require-

ments of the PCT in respect of novelty and inventive step (Article 33(3) PCT), the reasons being as follows:

Claims 6-9:

The use of shape recognition means operating in the optical frequency domain is described in document D3 disclosing an interferometer for identifying trace constituents in a plasma during processing of semiconductors (cf. figure 4; column 7, line 67 - column 8, line 5; column 8, lines 11-12). In particular, D3 discloses the use of a Fabry-Perot etalon as well as the use of a tiltable narrow bandpass interference filter to scan a small range of wavelengths (cf. column 4, lines 34-39 and lines 48-51). The use of software as a shape recognition means operating in the optical frequency domain is described in D2 (cf. page 13, lines 16-19).

Claims 10, 11, 13-15, 24-27:

Radiation detecting means comprising a thin film filter or a monochromator and an interference device, in particular a Fabry-Perot interferometer, are disclosed in D3 (cf. column 7, line 67 - column 8, line 12; figure 4). The simultaneous examination of a plurality of spectral ranges is considered to be an obvious way of obtaining additional information about the process to be controlled.

Claims 16-23:

The use of a digital filter for determining the shape of the time evolving spectral output is known from D2 (cf. page 13, lines 20-29). The shape recognition methods of claims 17-23 are standard methods known to the skilled person. In particular the use of the Gradiometer, Fourier, and Liplike transforms is disclosed in D2 (cf. page 13, lines 29-32; page 14, lines 27-30).

Claims 28-30:

It is common general knowledge that gaseous compounds display characteristic fingerprints not only in emission but also in absorption. The observation of light absorption at a characteristic wavelength is therefore an obvious alternative for obtaining information about the gaseous species involved in the process. Lasers are standard light sources used in absorption spectroscopy.

Claim 31:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/02082

Plasma based processes are described both in D1 (cf. title) and in D2 (cf. title).

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D3 is not mentioned in the description, nor are these documents identified therein.
2. The description is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT.

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1 Claims

2

3 1. A method of automatically determining the progress
4 of a process using reactive species or generating
5 product species, including continuously monitoring
6 a predetermined frequency or frequency band of
7 radiation emitted from or absorbed by the species,
8 developing a graphical or numerical output
9 corresponding to the level of emittance or
10 absorption, and electronically comparing the shape
11 of that output with a predicted output or trend to
12 provide an indication of the progress of the
13 process.

14

15 2. A method as claimed in Claim 1, further comprising
16 generating a control signal for controlling the
17 process when a predetermined stage in the process
18 progress is attained.

19

20 3 A method as claimed in any one of Claims 1 or 2,
21 wherein the process is plasma based.

22

23 4. A method of processing a semiconductor workpiece
24 including determining the process progress as
25 claimed in any one of claims 1 to 3 and
26 controlling the process in response to the
27 indication provided.

28

29 5. A process control system for controlling a process
30 using reactive species or generating product
31 species, including means for continuously
32 capturing an optical frequency differentiated
33 sample of radiation from the process, a detector
34 for producing an output indicative of the time
35 varying intensity of the radiation, and shape
36 recognition means in the temporal domain for
37 comparing the output against a predicted output or

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15

- 1 trend to provide an indication of progress of the
2 process.
3
- 4 6. A system as claimed in claim 5, wherein the
5 optical frequency differentiated sample of
6 radiation is processed by a shape recognition
7 means operating in the optical frequency domain
8 prior to its processing in the time domain.
9
- 10 7. A system as claimed in claim 6, wherein the shape
11 recognition means operating in the optical
12 frequency domain is a specifically designed
13 'Fabry-Perot' etalon having a series of passbands
14 which are linearly separated in wavenumbers which
15 correspond to the vibrationally broadened
16 molecular series of the chemical constituent which
17 is characteristic of the process being monitored.
18
- 19 8. A system as claimed in claim 7, wherein the
20 'Fabry-Perot' etalon is scanned in centre
21 frequency by continuously tilting it about a rest
22 position.
23
- 24 9. A system as claimed in claim 6, wherein the
25 frequency differentiated sample of radiation is
26 derived from a monochromator means and the shape
27 recognition means operating in the optical
28 frequency domain is implemented in software
29 following the detection of the signal and its
30 conversion to an electrical signal.
31
- 32 10. A system as claimed in Claim 5, wherein the
33 radiation capturing means includes an optical
34 output, a thin film filter and an interference
35 device.
36
- 37 11. A system as claimed in Claim 10, wherein the
38 interference device is a 'Fabry-Perot' etalon.

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- 1
- 2 12. A process control system wherein a time evolving
- 3 spectral output from a reaction is detected by a
- 4 spectral detection means and then used in
- 5 combination with the application of shape
- 6 recognition techniques to provide a continuous
- 7 measure of process progress against a predicted
- 8 trend.
- 9
- 10 13. A process control system as claimed in Claim 12,
- 11 wherein the spectral detection means includes the
- 12 combination of a thin film filter with an
- 13 interference means.
- 14
- 15 14. A process control system as claimed in Claim 13,
- 16 wherein the interference means is a 'Fabry-Perot'
- 17 etalon.
- 18
- 19 15. A process control system as claimed in Claim 13,
- 20 wherein the interference means is a scanned
- 21 'Fabry-Perot'.
- 22
- 23 16. A process control system as claimed in any one of
- 24 claims 12 to 15, including a digital filter for
- 25 determining the shape of the time evolving
- 26 spectral output.
- 27
- 28 17. A process control system as claimed in any one of
- 29 Claim 12 to 15, wherein the shape recognition is
- 30 achieved by a series of masks derived from
- 31 different time epochs using a Gradiometer
- 32 transform.
- 33
- 34 18. A process control system as claimed in any one of
- 35 Claims 12 to 15, wherein the shape recognition is
- 36 achieved by a series of masks derived from
- 37 different time epochs using a Fourier Transform.
- 38

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17

- 1 19. A process control system as claimed in any one of
2 claims 12 to 15, wherein the shape recognition is
3 achieved by a series of masks derived from
4 different time epochs using a Laplace Transform.
5
- 6 20. A process control system as claimed in any one of
7 claims 12 to 15, wherein the shape recognition is
8 achieved by a series of masks derived from
9 different time epochs using the Kohonen self
10 organising map.
11
- 12 21. A process control system as claimed in any one of
13 claims 12 to 15, wherein the shape recognition is
14 achieved by a series of masks derived from
15 different time epochs using the cellular neural
16 network paradigm.
17
- 18 22. A process control system as claimed in any one of
19 claims 12 to 15, wherein the shape recognition is
20 achieved by a series of masks derived from
21 different time epochs using Polynomial
22 Interpolated Measures.
23
- 24 23. A process control system as claimed in any one of
25 claims 12 to 15, wherein the shape recognition is
26 achieved by a series of masks derived from
27 different time epochs using the method of
28 Fractals.
29
- 30 24. A process control system as claimed in any one of
31 Claim 12 to 23, wherein the spectral detection
32 means includes a dispersive grating monochromator.
33
- 34 25. A process control system as claimed in any one of
35 claims 12 to 23, wherein the spectral detection
36 means includes a scanned 'Fabry-Perot'
37 interferometer.
38

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- 1 26. A process control system as claimed in any one of
2 Claims 12 to 23, wherein the spectral detection
3 means includes a Fourier Transform Spectrometer.
4
- 5 27. A process control system as claimed in any one of
6 claims 12 to 26, wherein a multiplicity of
7 spectrum parts are examined simultaneously.
8
- 9 28. A process control system as claimed in any one of
10 claims 12 to 26, wherein the spectral detection
11 means detects the absorption spectrum of light of
12 a particular characteristic wavelength.
13
- 14 29. A process control system as claimed in any of
15 claim 28, including a laser as a light source for
16 providing the light of the particular wavelength.
17
- 18 30. A process control system as claimed in any of
19 claims 29, including a frequency swept laser as
20 the light source.
21
- 22 31. A process control system as claimed in any one of
23 Claims 12 to 26, wherein the process is plasma
24 based.
25

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference P22105/GWO	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 99/ 02082	International filing date (day/month/year) 12/07/1999	(Earliest) Priority Date (day/month/year) 11/07/1998
Applicant VORGEM LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

4

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

T/GB 99/02082

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N21/73

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 27 36 262 A (NORTHERN TELECOM LTD) 16 March 1978 (1978=03-16) page 6, paragraph 1 -page 7, paragraph 1 page 8, paragraph 3 -page 9, paragraph 1 page 9, paragraph 3 -page 10, paragraph 1 page 13, paragraph 2 figures 2,3	1-6
Y	---	11,12
Y	US 5 225 888 A (SELWYN GARY S ET AL) 6 July 1993 (1993-07-06) column 3, line 60 -column 7, line 11 column 7, line 48 -column 8, line 60 figure 4	11,12
A	---	4,5,8,9, 15,16, 26,32
	--- -/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

27 October 1999

Date of mailing of the international search report

05/11/1999

Name and mailing address of the ISA

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Authorized officer

Krametz, E

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/02082

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 290 383 A (KOSHIMIZU CHISHIO) 1 March 1994 (1994-03-01) column 4, line 34 -column 5, line 47 ---	1-6
A	WO 98 07002 A (BECKMANN WILLIAM GEORGE ; VORGEM LIMITED (GB); HICKS SIMON ERIC (GB) 19 February 1998 (1998-02-19) cited in the application claims 4-6 -----	18-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/02082

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 2736262	A	16-03-1978	CA 1071579 A	12-02-1980
			FR 2364593 A	07-04-1978
			GB 1569939 A	25-06-1980
			JP 53034641 A	31-03-1978
			JP 60013072 B	04-04-1985
			NL 7707198 A	15-03-1978
			SE 439266 B	10-06-1985
			SE 7710257 A	14-03-1978

US 5225888	A	06-07-1993	JP 2059255 C	10-06-1996
			JP 4303745 A	27-10-1992
			JP 7092435 B	09-10-1995

US 5290383	A	01-03-1994	JP 5206076 A	13-08-1993
			JP 2936501 B	23-08-1999
			JP 5206078 A	13-08-1993
			JP 4338663 A	25-11-1992
			JP 2906752 B	21-06-1999
			JP 5029276 A	05-02-1993
			JP 5102089 A	23-04-1993
			JP 5102086 A	23-04-1993
			JP 2913125 B	28-06-1999
			JP 5036644 A	12-02-1993
			US 5322590 A	21-06-1993

WO 9807002	A	19-02-1998	AU 3856897 A	06-03-1998
			EP 0917642 A	26-05-1999

ATENT COOPERATION TR. TY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 04 March 2000 (04.03.00)	
International application No. PCT/GB99/02082	Applicant's or agent's file reference P22105/GWO
International filing date (day/month/year) 12 July 1999 (12.07.99)	Priority date (day/month/year) 11 July 1998 (11.07.98)
Applicant HOLBROOK, Mark, Burton et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
04 February 2000 (04.02.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer S. Mafla
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38